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Bean Tunnel

Lighting Design Report

Balfour Beatty

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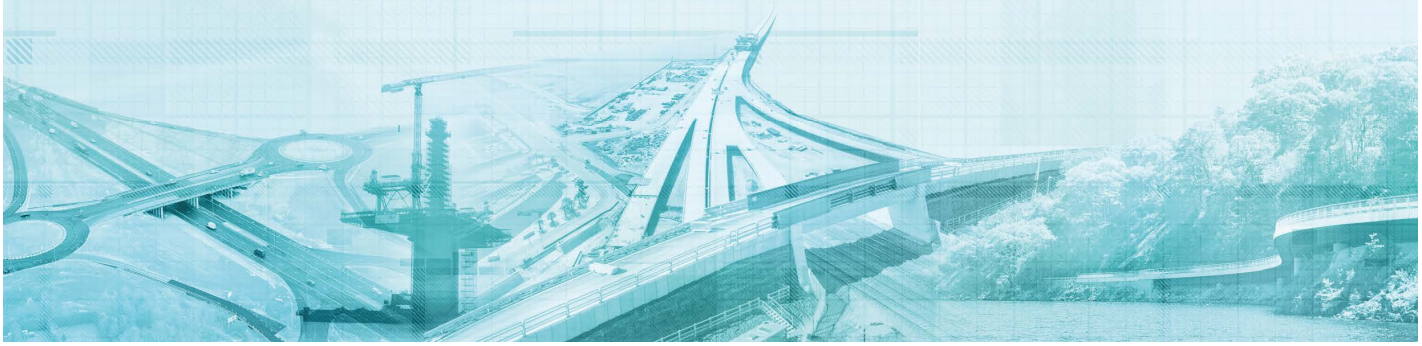

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Appendix

Scheme Description

1.1. Overview

1.1.1. The scheme is to provide a detailed lighting and electrical design for an 80m tunnel and new junction which links from the tunnel to the existing road network.

1.1.2. The detailed lighting design is to be based on the preliminary design carried out by Jacobs.

1.1.3. The scheme has three main elements.

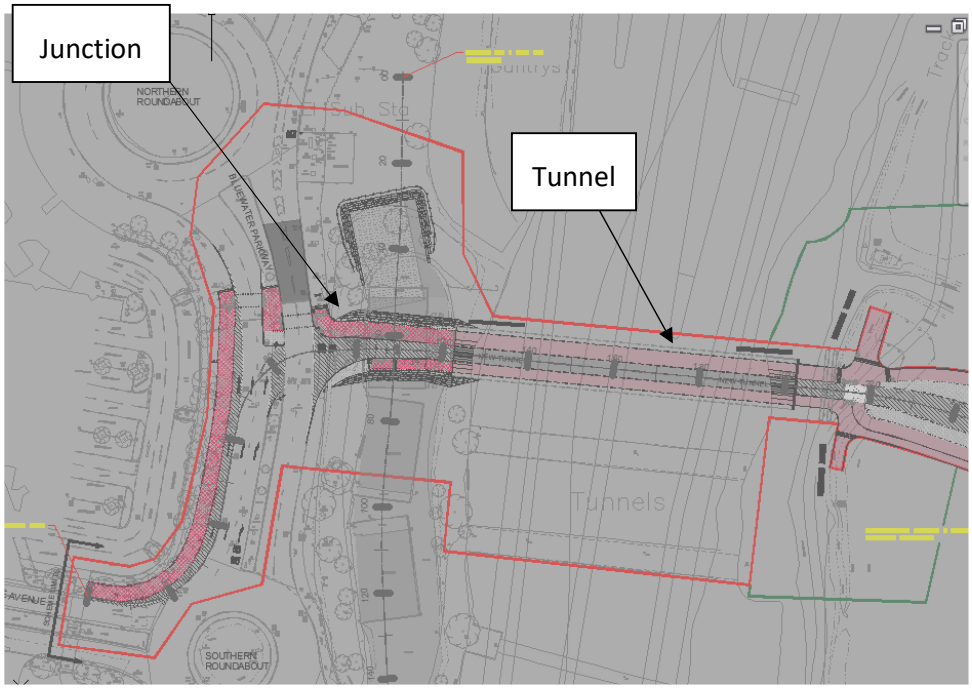
a. Functional lighting for the tunnel.

b. Feature lighting for the tunnel.

c. Functional lighting for the junction.

1.1.4. The scheme location plan is shown below in Figure 1.

Figure 1 - Location Plan



1.2. Existing Road Lighting Provision

1.2.1. There is an extensive system of lighting that exists on the western side of the proposed tunnel which lights the large Bluewater car parks and perimeter road (Bluewater Parkway).

1.2.2. The existing lighting is made up of 5m, 8m and 10m conical columns. There are a variety of bracket outreaches throughout the site ranging from 0.55m to 1.5m. The existing luminaires installed are the DW Windsor RIO 450 and 500. The existing luminaires were originally installed with conventional lamps and have recently gone through an LED upgrade where the gear trays were replaced.

1.2.3. The LED upgrade lighting has a Colour Correlated Temperature (CCT) of 4000k and has four-step dimming as follows.

i. Switch on at full output at dusk.
ii. Dim to 50% output at midnight.
iii. Return to full output at 6am.
iv. Switch off at dawn.

1.2.4. The existing lighting is believed to be owned and maintained by Incentive FM on behalf of Bluewater.

1.2.5. The existing columns, brackets and luminaires are all finished Bluewater Aubergine PSX700.

1.3. Existing Power Supply

1.3.1. Records show that the existing lighting is all fed via an extensive private cable network from the existing Bluewater substation.

2. Environmental Considerations

2.1. Known Issues

2.1.1. There are no properties in the vicinity of the area to be lit.

2.1.2. Bats are known to be widespread throughout the area. Lighting may impact on one or more features suitable for roosting bats and affect bat foraging habitats and/or disrupt commuting routes. Mitigation for this is detailed in Section 2.2

2.2. Environmental Mitigation

2.2.1. The detailed lighting design aims to minimise adverse impacts on the surrounding landscape and ecology. The visual impact and light spill (behind the luminaire and above the horizontal) that could affect the environment has been minimised by;

a. Using LED lighting which has no UV content.
b. For the two proposed luminaires lighting the new junction, an LED CCT of 3000K has been used.
c. Using optics which direct the light where required.

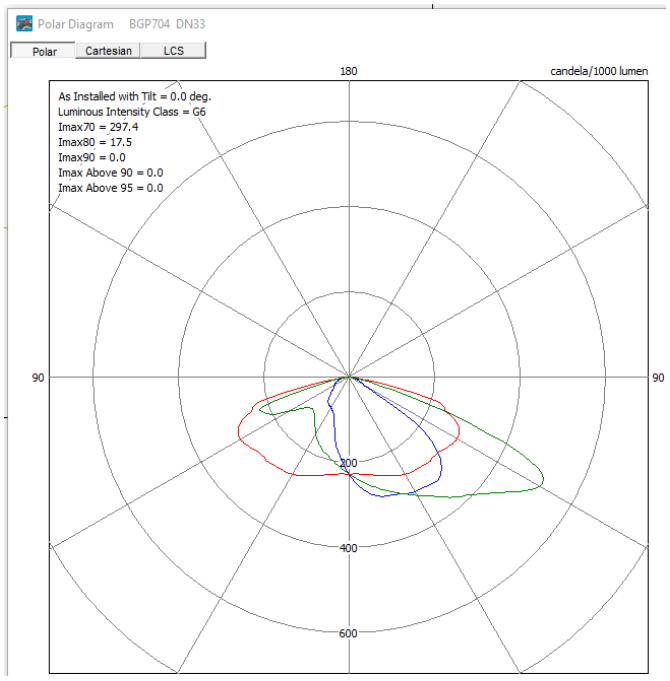
d. Dimming the luminaires as per the existing system of lighting (See Section 1.2.3)

e. The existing lighting on the Bluewater Parkway is made up of 10m columns. The proposed lighting for the new junction will be using 8m columns.

f. A small outreach bracket is proposed to reduce back light and bring the light forward onto the road and footways.

g. The LUMA luminaires lighting the new junction have internal full cut off louvres which greatly reduce the rear light spill. The optic settings achieve the most stringent luminous intensity class of G6. This means that there is no direct light emitted from the luminaire above 90 degrees as shown in Image 1.

Image 1 – Polar diagram for LUMA Medium (BGP704)



3. Proposed Lighting

3.1. Lighting Asset Ownership

3.1.1. It is intended that the proposed lighting for the tunnel be owned and maintained by Kent County Council (KCC)

3.1.2. It is intended that all proposed lighting outside of the tunnel will be owned and maintained by Incentive FM on behalf of Bluewater.

3.2. Standards, Guidance, and client requirements

3.2.1. The following standards and guidance have been used throughout the design process.

3.2.2. BS 5489-1:2013 - Code of Practice for the Design of Road Lighting. Lighting of Roads and Public Amenity Areas

3.2.3. BS 7671:2018 - Requirements for Electrical Installations IET Wiring regulations 18th Edition incorporating Amendment 1 Jan 2020

3.2.4. BS EN 13201-2:2015 - Road Lighting – Part 2: Performance Requirements

3.2.5. ILP PLG02: 2013 – The Application of Conflict Areas on the Highway

3.2.6. CIE 88:2004 – Guide for the Lighting of Road Tunnels and Underpasses.

3.2.7. Guidance Note 08/18 ILP Document: Bats and artificial lighting in the UK – Bats and the Built Environment Series

4. Detailed Lighting Design

4.1. Junction Lighting

4.1.1. Road lighting classes are taken from BS5489-1:2020 with lighting levels for the selected classes taken from BS EN 13201:2015.

4.1.2. The proposed lighting of the new junction will be in the form of column mounted luminaires. The column and bracket type are to match the existing system of lighting already installed around the Bluewater development. They are to be finished in the same colour to match the existing. It is proposed that the luminaires be controlled via miniature photocells with the same dimming levels as stated in Section 1.2.3

4.1.3. The Philips LUMA (BGP704) luminaire proposed to light the new junction utilises an LED light source with a CCT of 3000K and has internal full cut off louvres. This has been chosen to reduce the impacts on the surrounding bats.

4.1.4. The chosen optic achieves a G6 luminous intensity class.

4.1.5. The height of the proposed columns lighting the junction is 8m. The height of the columns on the Bluewater Parkway are to be 10m to match the existing heights. Bracket outreaches for the two new columns is to match the length of the ones that they are replacing.

4.1.6. The calculated lighting levels for the new junction can be found in Lighting Reality calculation **BRT-TG-XX-ZZ-CA-LI-1301.**

4.1.7. Except for LC08A/B which is on the traffic island. It is proposed that the other three columns are to be positioned at the rear of the footway.

4.1.8. The proposed lighting design for the new junction ties in with the existing system of lighting as shown on lighting calculation **BRT-TG-XX-ZZ-CA-LI-1301.**

4.1.9. Proposed column locations are shown on drawing no. **BRT-TG-XX-ZZ-DR-LI-1302.**

4.1.10. Column specifications can be found in SHW Series 1300.

4.1.11. Luminaire specifications can be found in SHW Series 1400.

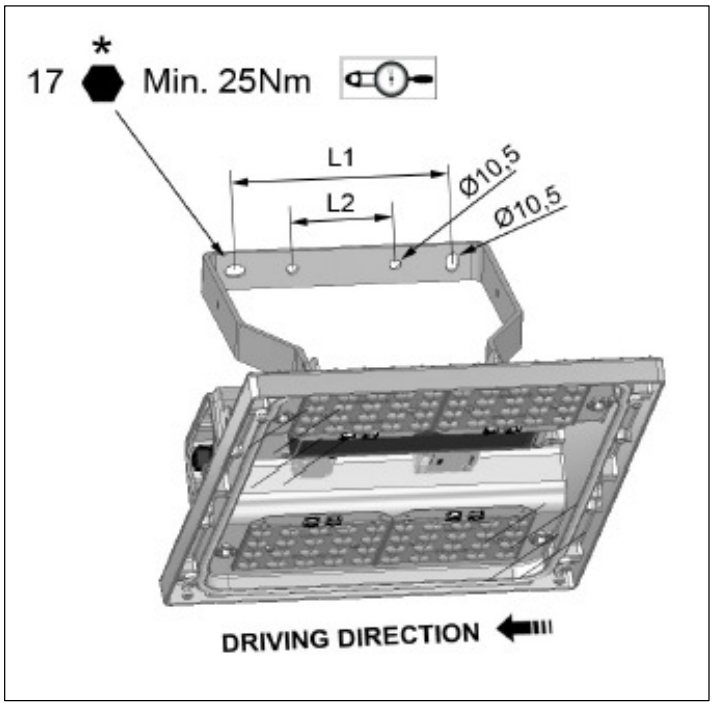
4.2. Tunnel Lighting – Functional

4.2.1. Lighting levels for the tunnel are taken from BS5489-1:2013.

4.2.2. The lighting of the tunnel will be provided by seven ceiling mounted Signify Large Tubepoint LED luminaires. These units are specifically designed for the lighting of such areas.

4.2.3. The functional luminaires are to be aimed directly down and mounted on brackets as shown in figure 2.

Figure 2 - Signify LED luminaire with MBA bracket



4.2.4. The location of the functional tunnel lighting can be found on drawing no. **BRT-TG-XX-ZZ-DR-LI-1301.**

4.2.5. The CCT of the LEDs in the tunnel luminaires is to be 4000K. This will match the CCT of the junction lighting and provide a good quality of lighting for both bus drivers and pedestrians.

4.2.6. Emergency lighting is being provided for the tunnel. Lighting levels for which are taken from CIE 88:2004.

4.2.7. It is proposed that the emergency lighting will be provided by three of the seven tunnel luminaires. Should there be a power failure, it is proposed that the power for the emergency lighting will be from an Uninterruptible Power Supply (UPS).

4.2.8. The UPS has been designed so that the emergency lighting levels can be maintained for a period of 60 minutes.

4.2.9. It is proposed that the UPS will be positioned on the eastern side of the tunnel and as shown on drawing no. BRT-TG-XX-ZZ-DR-LI-1301.

4.2.10. The lighting levels achieved for the new tunnel can be found in Relux Lighting calculation BRT-TG-XX-ZZ-CA-LI-1302.

4.2.11. The lighting of the tunnel is split into daytime and night-time (dusk till dawn) levels.

4.2.12. To achieve the required lighting levels for the daytime it is proposed that all seven tunnel luminaires be dimmed down to 90% output.

4.2.13. To achieve the night- time levels, it is proposed that the tunnel luminaires be dimmed down to 30% output.

4.2.14. It is proposed that the tunnel lighting be controlled via an astronomical time clock housed in the feeder pillar on the east side of the tunnel. Kent County Council Central Management System (CMS) was considered for the control of the functional tunnel lighting; however, the manufacturer of the luminaires has confirmed that there is not sufficient space to house the required antenna. There would also be considerable difficulties in getting a signal from the luminaires back to the control point.

4.2.15. Luminaire specifications can be found in SHW Series 1400.

4.3. Tunnel Lighting – Feature

4.3.1. In addition to the functional lighting of the tunnel, it is proposed to provide a blue feature lighting effect.

4.3.2. There are no specific lighting levels required for the feature lighting as it is just a visual effect.

4.3.3. The feature lighting will be provided by installing 90 Colorgraze MX4 Powercore RGBW (Red, Green, Blue, White) LED luminaires from Colour Kinetics on the inside of the tunnel at a height of 3m and near the top of the tunnel cladding. The feature lighting will start 4.4m from the tunnel entrance. This is to reduce the blue spill light

outside of the tunnel and ensure that the negative impact on the bats is minimised as far as is reasonably practicable.

4.3.4. The highest calculated level of blue horizontal spill light outside of the tunnel entrance during the night-time period (dusk till dawn) is 0.2 lux as can be seen by the orange colour in the image below.

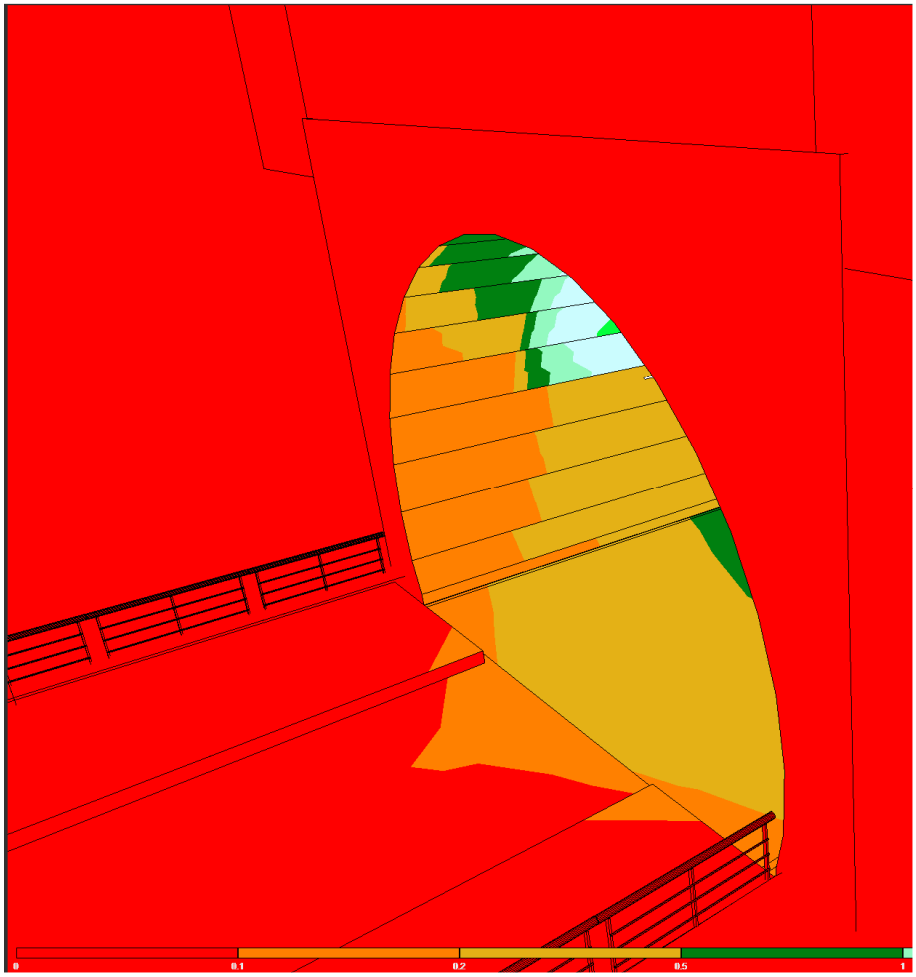


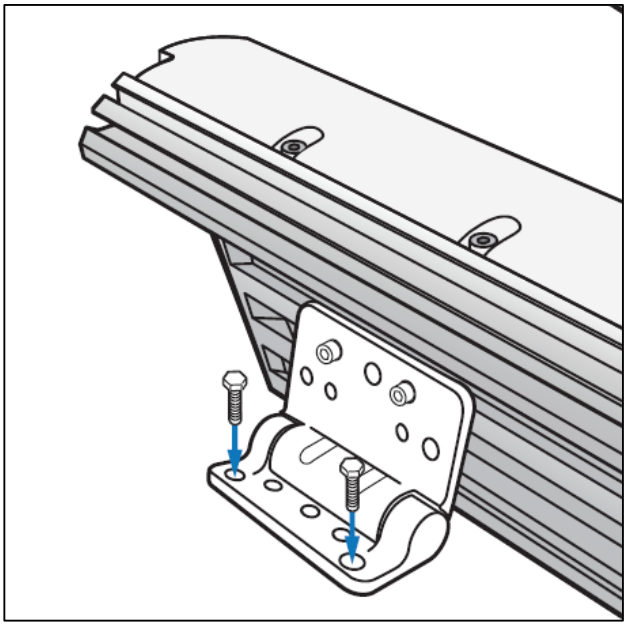
Image 2 – 3D image showing blue horizonal spill light

4.3.5. The RGBW luminaires can create almost any colour of light by dimming the individual channels. The exact shade of blue can be adjusted by adding red or green as required. Other colour effects can be programmed via the PHAROS Touch Panel Control unit for special occasions as required.

4.3.6. The feature LED lighting luminaires will be aimed 30 degrees from the vertical towards the centre of the tunnel.

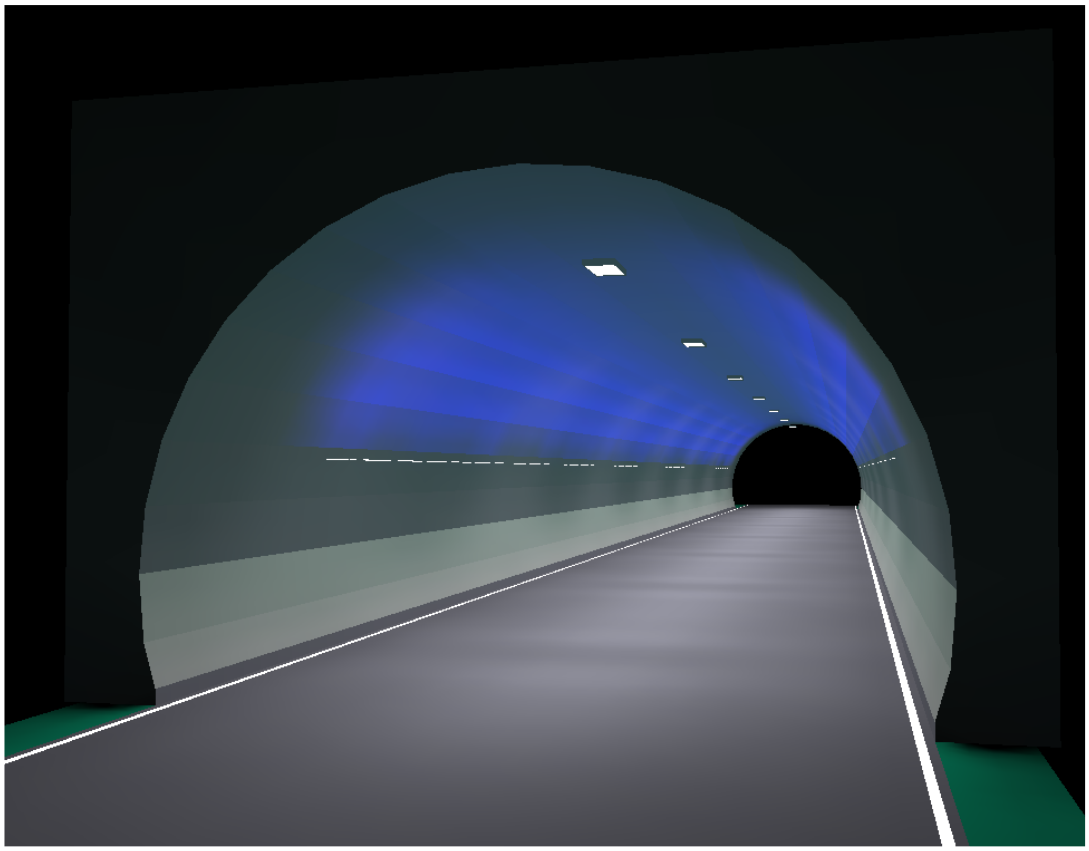
4.3.7. It is proposed that the feature lighting be installed with the manufacturers brackets as shown in figure 3.

Figure 3 - Feature lighting method of installation



4.3.8. The indicative effect of the blue lighting can be seen in Image 1.

Image 3 – Visualisation showing Tunnel with blue feature lighting effect



4.3.9. The feature lighting will be in addition to the functional lighting and will not be powered by the UPS in the event of a power failure.

4.3.10. It is proposed that the feature tunnel lighting be dimmed by the same percentages as stated in Section 4.2.12 and 4.2.13.

4.3.11. Luminaire specifications can be found in SHW Series 1400.

5. Proposed Power Supply Provision

5.1. Junction Lighting

5.1.1. It is proposed that the junction lighting be fed via a private cable network (PCN) from a feeder pillar near the junction with Bluewater Parkway.

5.1.2. The new feeder pillar will require a single phase DNO (LV) connection which is proposed to be taken from the existing Bluewater sub-station.

5.1.3. It is proposed that LC05A/B and LC08A/B will be fed via the existing PCN subject to the condition of the existing cables and ducts.

5.1.4. Chambers will be required for road crossings. Chamber locations and indicative duct routes are shown on drawing no. **BRT-TG-XX-ZZ-DR-LI-1302.**

5.1.5. It is proposed that the suite of existing KCC standard details will be utilised for this scheme for both the tunnel and junction lighting.

5.1.6. The electrical schematic for the junction lighting is on drawing no. **BRT-TG-XX-ZZ-DR-LI-1401.**

5.1.7. Cable types, feeder pillar specifications and ancillary equipment can be found in SHW Series 1400.

5.1.8. Cable duct specification can be found in SHW Series 500.

5.2. Tunnel Lighting

5.2.1. It is proposed that the functional and feature lighting be fed from a feeder pillar located at the eastern end of the tunnel and at the rear of the northern footway. The feeder pillar will require a single phase DNO (LV) supply taken from a new substation (Whitecliffe). The location for which was not known at the time of design.

5.2.2. Cabling from the feeder pillar for the tunnel will need to run in steel conduit up to a minimum height of 2.5m to ensure that they are not accessible to the general public. After which, cables will need to be mounted on cable trays.

5.2.3. Should there be a power failure, the tunnel will automatically switch to run for 60 minutes from a UPS.

5.2.4. The UPS and enclosure specification are as follows.

a. Ground mounted ALPHA ATROX 55_200w 60AH IP55 Cabinet.

b. APLHA FXM HP 2000 Rugged UPS Module

c. ALPHA GEL Batteries

5.2.5. The electrical schematic for the functional lighting is on drawing no. **BRT-TG-XX-ZZ-DR-LI-1403.**

5.2.6. The electrical schematic for the feature lighting is on drawing no. **BRT-TG-XX-ZZ-DR-LI-1403.**

5.2.7. A line drawing showing how the feature lighting is to be cabled can be seen on drawing no. **BRT-TG-XX-ZZ-DR-LI-1303.**

5.2.8. Cable types, feeder pillar specifications and ancillary equipment can be found in SHW Series 1400.

5.2.9. Cable duct specification can be found in SHW Series 500.

6. Assumptions and Risks

6.1. Tunnel and Junction Lighting

6.1.1. The proposed numbering of lighting luminaires and feeder pillars is for reference purposes only. The asset owner shall provide confirmation of final numbering.

6.1.2. No detailed information exists stating the projection length of the existing brackets for the columns that are to be removed from site. As it proposed that new columns and brackets will be installed to replace these, assumptions have had to be made regarding the projection of the new bracket lengths.

6.1.3. No existing test certificates have been provided for the existing Bluewater lighting and as such, certain assumptions have had to be made during the design of the electrical schematics.

6.1.4. The final blue colour of the feature tunnel lighting would need to be determined by an onsite trial, for which at present there is an 8-week lead time. The images in the 3D calculation should not be relied upon for accuracy of colour.

6.1.5. It is proposed that the existing cables and ducting currently supplying RM05A/B and RM08A/B can be re-used subject to condition. If this is not possible, then new ducting and cables will be required as per the existing and in compliance with BS 7671:2018+A1:2020.

6.1.6. It is more common for a UPS to be housed in a plant room or at least in an internal space within the tunnel. Housing a UPS external to a tunnel is not common practice and as such a bespoke enclosure solution is having to be designed to ensure that the optimal operating temperature of the UPS can be maintained.

7. Submitted Documents

7.1. Lighting

7.1.1. **BRT-TG-XX-ZZ-CA-LI-1301** [Lighting calculation for the proposed junction]

7.1.2. **BRT-TG-XX-ZZ-CA-LI-1302** [Lighting calculation for the proposed tunnel]

7.1.3. **BRT-TG-XX-ZZ-DR-LI-1301** [Lighting Layout drawing for the tunnel]

7.1.4. **BRT-TG-XX-ZZ-DR-LI-1302** [Lighting Layout drawing for the junction]

7.1.5. **BRT-TG-XX-ZZ-DR-LI-1303** [Feature Tunnel Lighting Installation Layout]

7.2. Electrical

7.2.1. **BRT-TG-XX-ZZ-DR-LI-1401** - Electrical Schematic (Tunnel Lighting)

7.2.2. **BRT-TG-XX-ZZ-DR-LI-1403** - Electrical Schematic (Junction Lighting)

7.2.3. **BRT-TG-XX-ZZ-DR-LI-1311** – Feeder Pillar Layout (FP01)

7.2.4. **BRT-TG-XX-ZZ-DR-LI-1404** – Feeder Pillar Layout (FP02)

7.2.5. **BRT-TG-XX-ZZ-CA-LI-1401 –** Cable Calculation

7.3. Supporting Documents

7.3.1. **BRT-TG-XX-ZZ-SP-LI-200 [Specification Appendices** – Site Clearance]

7.3.2. **BRT-TG-XX-ZZ-SP-LI-500 [Specification Appendices** – Service Ducts]

7.3.3. **BRT-TG-XX-ZZ-SP-LI-1300 [Specification Appendices** – Road Lighting Columns and Brackets]

7.3.4. **BRT-TG-XX-ZZ-SP-LI-1400 [Specification Appendices** – Electrical Work for Road Lighting]

7.3.5. **BRT-TG-XX-ZZ-RP-LI-1301** [Lighting Design AIP]

7.3.6. **BRT-TG-XX-ZZ-RP-LI-1302** [Lighting Design Report]

7.3.7. **BRT-TG-XX-ZZ-RA-LI-0001** [Lighting Design Risk Assessment]